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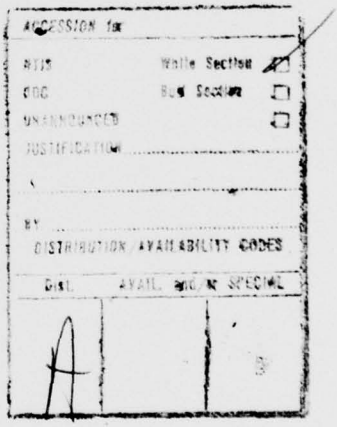
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HARWELL STUDIES OF MAGNET TOLERANCES FOR THE NEW STYLE SYNCHROTRON

Preliminary results from the orbit-tracing calculations at Harwell, mentioned in ESN 7, 67 (1953), are now available. The work has been done by Drs. J.B. Adams, M.G.N. Hine, and J.D. Lawson, using the automatic computing engine (ACE digital computer) at the National Physical Laboratory, Teddington. Their results indicate that Lawson's rough statistical calculation for the build-up of oscillation during a single revolution in the new type synchrotron, is reasonably accurate. Lawson's result, described earlier in ESN, suggested that small random radial (or vertical) errors in the positioning of magnet sectors could cause very serious oscillations to develop even in a single revolution. This makes it appear that in a machine such as that envisaged by Courant, Livingston, and Snyder (Phys. Rev. 88, 1190 (1952)) the rms misalignment of the 240 sectors must be kept less than about 0.013", or some other method of compensation employed, in order to keep the particles from hitting the walls during the first revolution.

Development of Oscillation During Several Revolutions

Adams, Hine, and Lawson have also considered the question of the build-up of oscillations upon subsequent revolutions. The subsequent development of oscillation depends critically on the change of phase of the oscillation after one revolution. If this is called ϕ where $-\pi \leq \phi \leq \pi$, then in a linear system, (i.e. where

the field index $n = -\frac{r}{H} \cdot \frac{dH}{dr}$ is constant), the oscillation amplitude varies sinusoidally with an amplitude of about $2A/\phi$ and a period of π/ϕ. Here A is the amplitude of oscillation after one revolution. If $\phi = 0$ the system resonates and the oscillation grows without limit. It is therefore essential to operate away from resonance in a linear system. If the system is linear but there is a slight variation in n from sector to sector, Adams et al., find that even for a perfectly aligned machine there will be a roughly exponential growth of oscillation if ϕ lies close to zero or close to π. In the general case of a misalignment where n depends upon displacement both linear and exponential resonances will occur. They find that for the 30 Bev accelerator proposed, a variation in n of 1.4 per cent changes ϕ from zero to π. Consequently, if it is intended to make the system linear and operate off resonance it will be necessary to control n during the acceleration to less than this amount.

On the other hand, the development of resonant oscillation might be limited by deliberately introducing considerable non-linearity. The behavior of such a system has been studied with the ACE computer using two different non-linear equations and introducing a constant forcing impulse once per revolution. The equations studied were the pendulum equation $\ddot{y} + \frac{n}{r} \sin y = 0$ and also the more realistic equation $\ddot{y} \pm n \sin y = 0$ where the sign alternates between focusing and defocusing sectors. In this work the ends of the sectors were assumed to be randomly distributed at a given distance from a circle. The trajectory was computed for one revolution using 25 randomly chosen sector arrangements, and for one typical sector-distribution the calculation was extended to 60 revolutions for various values of alignment accuracy.

For both equations it was found that A' where $\phi(A') = \pi + \phi(0)$ was an important parameter. For the pendulum equation and sufficiently small impulses, the behavior was like that of a linear system when ϕ was not near zero. When ϕ was close to zero the amplitude was found to vary periodically and was limited to about A'. For impulses large enough to make A greater than A'/5 the amplitude built up indefinitely.

The results with the second equation were similar except that for the bounded solutions the amplitude did not show such a systematic behavior, and it was not certain that some of the solutions would not have diverged if the calculation had been extended to a larger number of revolutions. It seemed to be possible, however, to set a limit

of stability corresponding to holding the sector tolerances to about ± 0.007" when the amount of non-linearity was adjusted so that A' was equal to the 1" half-width of the chamber.

Adams, Hine, and Lawson conclude from their results that great care must be used in the magnet design of strong focusing synchrotrons. Their calculations suggest that if the tolerances can be held well enough to get the beam around once, either a linear or a non-linear system might be used provided that the field can be precisely controlled during acceleration. Adams, Hine, and Lawson point out that they do not consider these calculations definitive, but only indicative of the care which must be used in magnet design and construction. It will be necessary to consider also the effect of inhomogeneities caused by inaccuracies in magnet shape, the effect of fringing fields, and to study the influence of the coupling between vertical and horizontal oscillations.

The synchrotron studies at Harwell are being made in cooperation with the proton synchrotron group of the European Council for Nuclear Research. It appears probable that Hine and Adams will join this group to assist in the design and construction of a European machine at Geneva if one is built.

PROPOSED COULOMB EXCITATION OF NUCLEI

At a recent colloquium in the Institute for Theoretical Physics, Copenhagen, Dr. B.R. Mottelson discussed a novel proposal for producing excitation of nuclear states. Mottelson's proposal was to bombard atomic nuclei with charged particles whose energy is well below the barrier. The probability of penetrating the barrier would consequently not be appreciable, and the nucleus would experience only the Coulomb field. Thus the excitation resulting from the pulse of electromagnetic energy would reflect the properties of the target nucleus free from complication by the nuclear force between target and projectile.

Principle of the Method

Mottelson outlined a classical treatment of the problem. A criterion for the validity of such an approach is that the parameter $K = \frac{2Z_1Z_2e^2}{\hbar v} \gg 1$, a condition which is easily realized, particularly for heavy ions bombarding all but the lightest nuclei. The Coulomb field at the nucleus is then treated as a time-dependent perturbation with its value as a function of time and position determined from the known Kepler orbit of the bombarding particle. The

Coulomb potential may be decomposed into electric multipoles, and a treatment much like that of Fermi for the similar problem in atomic excitation may be carried out.

The Coulomb field will contain a very large number of electric multipoles of comparable intensity; however, because the speed of the bombarding particle is small compared to that of light, magnetic effects may be completely neglected. In this respect the method of excitation is analogous to a nuclear photo-effect produced by a hypothetical photon which had an electric vector but no magnetic vector. This treatment yields a differential cross section for each electric multipole order which contains the nuclear matrix element for the isomeric transition between the excited nuclear state and the ground state. The virtue of the type of excitation suggested is that the other factors which appear are completely susceptible to calculation. Consequently, in principle, the matrix element may be determined from a measurement of the differential cross section.

Possible Applications

The method suggested may provide an alternative technique for measuring transition probabilities of gamma ray transitions which are too short-lived for study by direct time measurement. In principle, the differential cross section for the process may be determined by counting the inelastically scattered particles. Measurement of the angular distribution of the gamma rays could give information on spins, and an absolute measurement of the number of gamma rays emitted in a specified direction would also give the nuclear matrix element.

The size of the effect predicted and some of the experimental difficulties can be seen by considering a specific possible experiment, namely the bombardment of Er^{166} with α-particles. An α-energy of 12 Mev, half the barrier height, is chosen to prevent barrier penetration. Mottelson finds, in this case, that the 80 kev state of erbium will be excited by the E2 multipole, the differential cross section at 180° for the process being about one fortieth of the Rutherford cross section. In this case the experimentalist is required to separate the inelastically scattered α particles which have lost 80 kev from the elastically scattered α particles and/or to distinguish 80 kev gamma rays from X rays.

Other Similar Theoretical Work

The possibility of using this general method of excitation had been considered earlier by Landau, and an estimate of the cross section was also made by another author. It appears, however, that previously the cross section has been radically underestimated and the method discounted. More recently Breit, Hull, and Gluckstern (Phys. Rev. 87, 74 (1952)) have considered bombardment by heavy ions in a different connection. Independently of Mottelson's work a detailed paper giving a full quantum mechanical treatment of the problem has recently appeared in Russian (Zh. Eksper. Teor. Fiz. 22, 284 (1952)).

MODEL OF NUCLEAR STRUCTURE

A. Bohr and B. Mottelson of the Institute for Theoretical Physics in Copenhagen have completed an extensive investigation of the properties of their model of nuclear structure (cf. ESN 6, 195 (1952)). The purpose of the present note is to describe further some of the qualitative features of the model and its success in explaining certain nuclear properties. Bohr and Mottelson plan to publish a full account of their work in English in Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. within the next few months.

Description of the Model

Bohr and Mottelson have been motivated to study a model embodying features of both shell structure and collective nuclear motions by the success of the shell and liquid drop models in separately describing different aspects of nuclear phenomena. At relatively low energies only a few nucleons can be excited and the behavior of these easily excited particles gives nuclear structure its characteristic independent particle features. However, the remaining nucleons which cannot be individually excited for small energies generally share some excitation energy and show their influence through collective motions of the nuclear field in which the few "individualistic" nucleons move. The formalism describes the nucleon density which defines the nuclear field in terms of a set of coordinates α. These coordinates are symmetrical functions of the individual nucleon coordinates (x). The way the former set of variables enter the nuclear dynamics can be appreciated best in the case where the frequencies ν of collective motion are much smaller than the frequencies ν' for the particle motion. Then in analogy with molecular structure the wave function has the adiabatic form $\psi_{n\nu}(x) = \psi_n(x,\alpha)\,\phi_\nu(\alpha)$.

Here the first factor is the shell model wave function, with quantum numbers n, corresponding to a fixed field having parameters α, while the second describes oscillations of the nucleus as a whole with fixed particle structure. A classical example which neglects nuclear compressibility serves as a good illustration of the role played by the α coordinates. Here the oscillations of the nuclear radius $R(\theta, \varphi)$ are carried out at constant volume and may be described in terms of the spherical harmonics $Y_{\lambda\mu}$ as follows:

$$R(\theta, \phi) = R_0 \left[1 + \sum_{\lambda\mu} \alpha_{\lambda\mu} Y_{\lambda\mu} (\theta, \phi) \right].$$

Coupling Between Particle and Collective Motions

The most important parameter in the model is the strength of coupling between particle and collective motions. For very small coupling the main features of a pure shell model are obtained; for stronger coupling an essentially different nuclear structure is found which, however, yields spins and parities of ground states and low-lying states not radically different from the shell model. For strong coupling the nucleons move independently relative to a statically deformed surface and the system of particles and surface has additional degrees of freedom corresponding to rotation and vibration. This latter case is somewhat analogous to the situation in molecular spectra and gives a much simpler spectrum than the intermediate coupling case where particle and surface spectra are not easily distinguished.

Reconciliation with the Shell Model

In the Bohr-Mottelson model the nuclear spin depends generally on both the configuration of the particles and the coupling with the nuclear surface. However, for many configurations the coupling yields the same spin given by the ordinary shell model; in particular, for single particle configurations the spin of the ground state generally equals that of the particle even if the coupling is strong and the particle angular momentum no longer is a good quantum number. Consequently the new collective model includes the shell model as a special case for the class of phenomena which the latter most successfully describes.

Nuclear Properties

The new model successfully yields a number of nuclear properties which do not appear compatible with the

shell model or its modifications which consider as perturbations the interactions between otherwise independent particles moving in a central potential. The deviation of magnetic moments from the Schmidt limits and the existence of quadrupole moments many times larger than can be attributed to a single particle, are phenomena which suggest that cooperative motions occur in nuclei, and in general the Bohr-Mottelson picture describes these features well. Also a number of isomeric transitions whose probabilities disagree strongly with the shell model can be accounted for. Generally, transitions within the particle structure which are found to be much less probable than the shell model predicts, are attributed to differences between the nuclear fields of the two states in question and a similar situation exists for many slow β-decays. Other transitions such as some of the anomalously fast (according to the shell model) electric quadrupole radiations have enhanced probabilities because of the oscillations of the nuclear surface. In addition the shell model finds it difficult to account for the fact that $(j)^3$ particle configurations are observed to have ground state spins of j in some cases and j-1 in others without violating known properties of the two-body nuclear system. In the Bohr-Mottelson model these observed ground state spins may be interpreted as arising naturally from the strength of the particle-surface coupling.

Coupling Strength and Existence of Rotational States

Analysis by Bohr and Mottelson of nuclear properties in the low energy region have provided considerable evidence regarding the strength of the surface-particle coupling. This appears to be strong except in the neighborhood of a closed particle shell. Beside such features as the variation of magnetic moments and electric quadrupole moments additional empirical evidence for rather strong coupling comes from the existence of collective excitations of the nucleus having rotational character. (See Physical Review 89, 316 (1953)).

Application to Higher Energies

The Bohr-Mottelson model may perhaps be applicable to the analysis of nuclear reaction data. Although the excitation involved in nuclear reactions is relatively high, the basic assumptions of the model should be valid until very great energies, sufficient to excite simultaneously a substantial fraction of the nuclear particles, are reached.

Experimental Confirmation

It is obvious that the Bohr-Mottelson scheme is susceptible to a very large number of experimental tests. However, it would be particularly desirable to confront it with detailed experimental evidence on the properties of the rotational states it predicts in even-even nuclei. Knowledge of the energies and life times of excited states of even-even nuclei would be important. If also it should be possible to measure magnetic moments and electric quadrupole moments of a few excited states whose lives were also known, the model would be subjected to a fairly severe test. Such measurements would be important both near closed shells and far from them in the region where strong coupling is expected to be fully developed.

AN INTERFEROMETER SPECTROGRAPH

Dr. Peter Fellgett (The Observatories, Cambridge) has pointed out that if light is transmitted through an interferometer, and if one leg of the interferometer is altered in length, then the resulting interferogram plotted as a function of the path difference will be the Fourier transform of the spectrum of the source. Because this technique utilizes all of the energy of the source simultaneously, it can be shown to yield a larger signal-to-noise ratio in a given time than conventional spectrographic methods. A preliminary description of Fellgett's ideas was given in Technical Report, ONRL-95-51 available from the Technical Publications Office, Code 740, Office of Naval Research, Washington 25, D.C. Dr. Fellgett is now building an unusual interferometer to apply his ideas to astronomical problems.

The design of this interferometer spectrograph is derived from the Michelson interferometer, but the usual mirrors are replaced by corner-cube reflectors. This has two advantages. First, the instrument will automatically be in adjustment, irrespective of the angular orientation of the reflectors. Second, the beam returning from each reflector is displaced from the incident beam with the result that the beam splitter can be made to serve as its own compensating plate. In Fellgett's design, the upper half of the beam splitter is partially silvered on the front surface, while the lower half is partially silvered on the rear surface. An additional advantage of the displaced beams is the fact that both beams emerging from the beam splitter can be used, whereas in the conventional design one of them is re-imaged on the source.

Fellgett plans to take advantage of the two beams

coming from the interferometer by imaging them on two receivers connected in opposition. Since the two beams will inherently be of opposite interferometric phase, they will produce signals which effectively add. The instrument is to be used primarily for observations on the near infrared spectra of stars, and lead sulfide conductive cells will be used. The signal will be recorded on a magnetic drum or tape and the spectrum analyzed from it by conventional frequency analysis techniques.

THE OXIDATION OF CARBON MONOXIDE

An informal one day symposium on the oxidation of carbon monoxide was recently held in the Chemical Engineering Department of Imperial College (London). It was organized by Drs. Burgoyne and G. Minkoff and was well attended by British workers in this field. In addition to British contributions, a communication from Dr. A. Gordon (NOTS, Inyokern) was read by Dr. Minkoff. A few of the results discussed are described in the following paragraphs. Further details can be found in Technical Report ONRL-37-53, available from the Technical Publications Office, Code 740, Office of Naval Research, Washington 25, D.C.

Several investigators have now shown that, contrary to earlier views, very small amounts of water vapor have a striking effect on the second explosion limit of dry $CO + O_2$. Dr. A. Gordon reported that addition of 0.004 per cent water lowers the second explosion limit from about 780°C to about 710°C. Further additions of water vapor have a less striking effect, although they continue to lower the limit. While these results were obtained in a closed system, Mr. Hirsch (London) confirmed them in experiments using a flow system. Mr. Hirsch also reported evidence for the presence of ozone in the system before explosion occurs. Dr. G. Minkoff and Dr. H. Broida (NBS, at present at Imperial College) are looking for ozone in spark-ignited explosions of $CO + O_2$ but their results are not yet conclusive. Definite results concerning the presence of ozone will be very useful in further elucidating the reaction mechanism.

The Band Spectrum of Carbon Monoxide Flames

Dr. D.A. Walsh presented an attractive interpretation of the well known band spectrum of carbon monoxide

flames. This is based on the model, that the emission occurs in a transition in which carbon dioxide drops from an upper, singlet excited level to a lower triplet excited level; the upper excited state is assumed to be linear, i.e., similar to the ground state, while in the lower excited state, a strongly bent shape is assumed for the molecule. This enables him to revise the previously attempted, essentially statistical correlation of Gaydon (cf. Spectroscopy and Combustion Theory, 1948, p. 68). Following Gaydon, the observed differences are grouped according to frequency of occurrence and assigned as follows (single prime refers to the upper state, double prime to the lower):

Most frequent: 565 cm^{-1} (ν_2''), 1130 ($2\nu_2''$), 1500 ($\nu_2'' + \nu_1''$)

Intermediate: 345 ($\nu_1'' - \nu_2''$), 925 (ν_1''), 1335 ($\nu_1' + \nu_2''$), 1700 ($3\nu_2''$), 2065 ($2\nu_2'' + \nu_1''$), 2260 ($4\nu_2''$)

Least frequent: 160 ($\nu_1'' - \nu_1'$), 230 ($\nu_1' - \nu_2''$), 515 (ν_2'), 780 (ν_1'), 1865 ($2\nu_1''$), 1915 ($\nu_1' + 2\nu_2''$).

It is interesting that this postulated bent, triplet state should have a relatively long lifetime; it may be responsible for the observed surface dependence of the second explosion limit, which implies that a relatively unreactive chain carrier can reach the surface.

The Oxidation of Carbon Monoxide by Nitrous Oxide

Dr. J.W. Linnett (Oxford) presented results on the oxidation of CO by N_2O, indicating that the unimolecular decomposition of N_2O into $N_2 + O$ is the initiating step. A mechanism, consistent with the following observations: (a) water is strongly catalytic at first, while further amounts have no added effect, (b) excess nitrous oxide has a catalytic effect, (c) excess carbon monoxide reduces the rate, is:

$$N_2O \longrightarrow N_2 + O,$$
$$O + H_2O \longrightarrow 2\ OH,$$
$$OH + CO \longrightarrow CO_2 + H,$$
$$H + N_2O \longrightarrow N_2 + OH.$$

COMPLEX CHEMISTRY OF THE U^{4+} ION

Dr. Sten Ahrland (Lund, Sweden) has made a comprehensive study of the complex chemistry of the uranyl ion (UO_2^{2+}) which has been reported in several articles in Acta Chemica Scandinavica (cf. 5, 1271 (1951)). He has recently extended his study to the complexes formed between the U^{4+} ion and chloride, bromide or thiocyanate ions. Their complexity has been potentiometrically determined by the ligand displacement method using acetate ion as the displacing ligand. The existence of the first complex $(UX)^{3+}$ for each system has been proved, and its constant

$$\beta_1 \equiv [UX]^{3+}/[U^{4+}]\,[X^-]$$

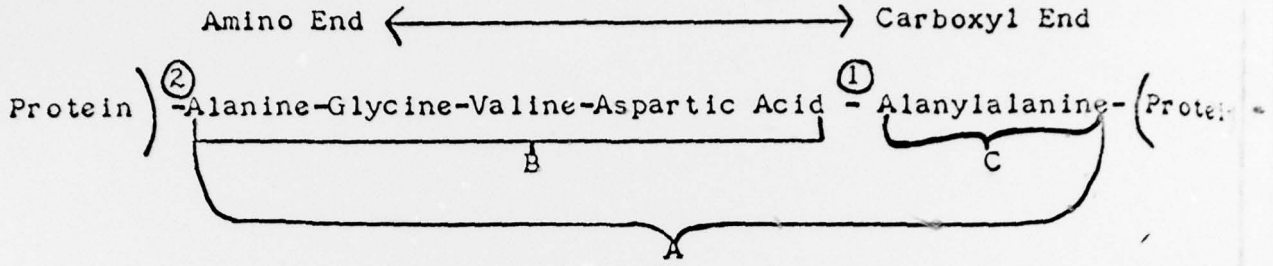
calculated for the chloride, bromide and thiocyanate systems to be 2.0, 1.5, and 15 - 20 reciprocal concentration units respectively. The complexes formed are very similar to those found with the uranyl ion, and the values of β_1 are approximately three times as great as those found for the uranyl ion. Dr. Ahrland is planning further work on the complex ion chemistry of the uranium fluorides.

PROTEIN CHEMISTRY AT THE CARLSBERG LABORATORY, COPENHAGEN

The Carlsberg Laboratories, which derive their support from the Carlsberg Breweries in Copenhagen, are engaged in an investigation of the fundamental processes involved in biochemical reactions. The physical chemistry of proteins is the main subject of investigation of the chemistry section under the direction of Professor K. Linderstrøm-Lang, who is himself primarily interested in the kinetics of biochemical reactions.

Transformation of Ovalbumin to Plakalbumin

The transformation of ovalbumin to plakalbumin by an enzyme preparation from "Bacillus subtilus" has been the subject of the research of a number of chemists at the Carlsberg Laboratory (cf. Ottesen and Wollenberger, Nature 170, 801 (1952); and Güntelberg and Ottesen, Nature 170, 802 (1952)). During this transformation a small amount of material containing non-protein nitrogen is released, and these peptides have been separated into three fractions designated A, B, and C. A and B are peptides composed chiefly of glycine, valine, aspartic acid, and alanine in the ratios 1:1:1:3 and 1:1:1:1, respectively, while C appears to be alanylalanine. It has been established that all three peptide fractions arise from the same portion of the ovalbumin molecule. A model of the ovalbumin molecule is shown below with the peptide fractions designated.



A kinetic study of this transformation is being made by Dr. Daniel Steinberg, on leave of absence from the National Health Institute, Bethesda. The experimental determination of the amount of each fraction formed as a function of time showed that the quantity of the C fraction rose very quickly to a steady state value. Similar results were obtained with portion A except that the final steady state value was much smaller than that of C. The B fraction on the other hand was very slowly formed but increased steadily. These measurements indicate that the ovalbumin chain is most easily broken at position 1 (indicated in the model) while not so easily broken at position 2. It follows that the B fraction must necessarily arise from a breaking of the bond at position 1 followed by a second breaking of the molecule at position 2. The experimental results would seem at first to indicate that this second breaking of the polypeptide chain was not very probable, whereas a consideration of the model would indicate that the B fraction attached to the protein molecule would be more easily broken off due to its freedom of movement in space than would the A fraction. This latter possibility has been confirmed by determinations of the velocity constants of these processes since their values are 0.20, 0.46, and 0.80 for the formation of the A, B, and C fractions, respectively. Thus the very slow appearance of the B fraction results from the low concentration of fraction B attached to the protein molecule at the start of the reaction, which gradually increases as fraction C is split off.

Molecular Weight of the Insulin Monomer

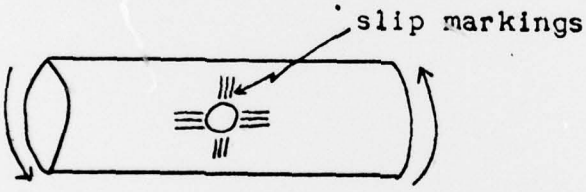
Dr. B. W. Kupke, an American postdoctorate working in Professor Linderstrøm-Lang's laboratory on the determination of the molecular weight of insulin by osmotic pressure measurements, has found some indication that the lowest molecular weight may be 6000. This molecular weight is exactly one half of that designated as the monomer by Doty and Myers at the recent Faraday Society Conference on the Physical Chemistry of Proteins.

Further information on physical chemistry research at Copenhagen may be obtained from Technical Report ONRL-43-53 available from the Technical Publications Office, Office of Naval Research, Code 740, Washington 25, D.C.

PLASTIC DEFORMATION AND FATIGUE

It is generally accepted that plastic deformation and the initiation of fatigue failure are inseparably associated. Previous work by a number of investigators has shown that the fatigue crack initiates in a deformed region, usually along a slip plane. H.L. Cox (National Physical Laboratory, Teddington) has conducted experiments which throw some doubt on this view and should provoke further research.

Cox has conducted torsional fatigue tests on cylindrical single crystals of aluminum through which a transverse hole had been made. It was observed during the course of the cyclic torsional stressing that slip bands formed in the 0 and 90° positions rather than at the 45° positions corresponding to the maximum resolved shear stress. This is shown schematically in the following figure:



Finally, after a sufficient number of stress reversals, a fatigue crack formed; but instead of initiating in the region of considerable slip, the crack occurred at the 45° position. The result is anomolous in view of previous work and merits further investigation.

ELLIOTT-N.R.D.C. COMPUTER

The Elliott-N.R.D.C. Computer 401 Mark I was developed by Elliott Bros., Ltd., (England) under a contract with the National Research Development Corporation. This machine operates at a fundamental digit rate of 330,000

per second and has a basic word length of 32 binary digits. The main store of the machine from which the clock pulses are derived is a magnetic wheel; and in addition to this there are short single-word nickel magnetostriction delay lines for the arithmetic registers (accumulator, multiplier, multiplicand, instruction, and one general purpose register).

This computer has been developed using small packaged units made by standard electronic techniques. The machine is made up of a total of 168 such units of sixteen different types, where three types represent 102 of the total number of units. An important feature of these logical units is that they are designed so that they could be used in the construction of machines of varying logical design, making it possible to build a complete machine in a very short time from a stock of such units.

A particularly novel detail of this machine is the iron oxide-coated magnetic-wheel storage unit. Instead of the normal drum construction, this magnetic storage unit takes the form of a disc 9 inches in diameter with the storage tracks located on one face. The wheel has a surface speed of 170 feet per second (4500 rpm) and contains eight tracks capable of storing 1024 words of 32 digits. The clearance between the read-write head and the wheel is 0.001 inch, and the distance between the tracks is 0.01 inch. The packing density employed on this wheel is 160 digits per inch.

Multiplication takes 6.5 milliseconds to perform and all other operations (transfers and additions) are carried out in 0.2 milliseconds. The machine is capable of solving 10 linear equations in 10 seconds, 20 in 1.5 minutes, and 30 in 10 minutes.

This computer is more fully described in Technical Report ONRL-39-53, copies of which are available from Office of Naval Research, Technical Publications Office, Code 740, Washington 25, D.C.

DIFFRACTION FRINGE CONTRAST MICROSCOPE FOR BIOLOGICAL STUDIES

Dr. R. Barer of the Department of Human Anatomy, Oxford, has invented a novel and simple form of diffraction microscope which may have usefulness in quantitative measurements on non-absorbing specimens. An ordinary microscope is used, modified in only two ways. The source of illumination is a slit, and a diffraction plate is inserted back of

the objective at any convenient point different from the rear focal plane. The diffraction plate consists of a plane parallel plate of glass over half of which is evaporated a transparent layer which introduces a difference in optical path of half a wave from the uncoated portion. In the absence of a specimen a system of fringes is found crossing the center of the field of view, similar to those recently described by Kastler. The slit must, of course, be properly oriented with respect to the interference plate.

When a transparent specimen is introduced into the region occupied by the fringes, the fringes are disturbed in such a way as to reveal the presence of the object. Dr. Barer has demonstrated that the lateral deviation of the fringes is proportional to the local gradient of the optical retardation, and thus the spacing of the fringes is proportional to the rate of change of the gradient. Dr. Barer is now exploring the possibility of using this technique for the refractometry of unstained cells.

TECHNICAL REPORTS OF ONRL

The following reports have been forwarded to ONR, Washington, since the last issue of ESN. Copies may be obtained from the Technical Publications Office, Code 740, Office of Naval Research, Washington 25, D.C.

ONRL-8-53 "Metals Research at the Institute for Theoretical and Applied Physics, Stuttgart" by J.R. Reitz

ONRL-22-53 "National Physical Laboratories, Israel" by S.F. Singer

ONRL-23-53 "Israel Defense Research Establishment" by S.F. Singer

ONRL-26-53 "Israel Atomic Energy Commission" by S.F. Singer

ONRL-29-53 "An Extracorporeal Heart-Lung Apparatus" by J.L. Nickerson

ONRL-30-53 "A Method for Measuring the Retinal Content of Visual Purple in the Intact Eye" by J.L. Nickerson

ONRL-31-53 "Research in the Physiology of Vision at the Institute of Ophthalmology, London" by C.H. Graham

ONRL-32-53 "Annual Report of the Noble Institute for Neurophysiology, 1952" by C.H. Graham

ONRL-34-53 "Psychology in Japan" by C.H. Graham

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